

FACTS



Ministry
of the
Environment

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DIOXIN BACKGROUND

What are PCDDs and PCDFs

The terms dioxin and furans refer to families of 75 related chemical compounds known as polychlorinated dibenzo-p-dioxins (PCDDs) and 135 related chemical compounds known as polychlorinated dibenzofurans (PCDFs) respectively.

These two families of compounds possess similar chemical structures, patterns of toxic and biological responses and may share a common mechanism of action at the cellular level.

The most toxic forms of PCDDs and PCDFs are those containing 4-6 chlorine atoms, with four of the chlorine atoms at the lateral positions, i.e., 2, 3, 7 and 8.

The 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-T₄CDD) is the most toxic of all the PCDDs and PCDFs.

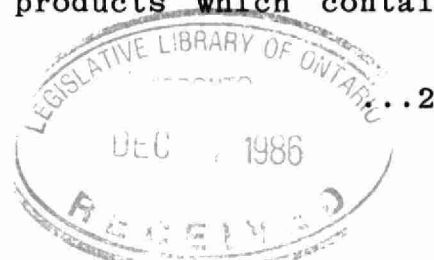
Octachlorodioxin is one of the least toxic forms of dioxin. The 2,3,7,8-T₄CDD dioxin, for example, is estimated to be 10,000 times more toxic than octadioxin. The octa form of dioxin is also among the most common. It can be produced through the incomplete combustion of fossil fuels like coal, or even cigarettes.

These compounds are not intentionally made for any purpose; they are unavoidable by-products created in the manufacture of other chemicals such as some pesticides, or as a result of incomplete combustion of mixtures containing chlorine atoms and organic compounds.

Occurrence in Ontario

In Ontario, there is no current chemical manufacturing of 2,3,5-trichlorophenol, nor formulation of 2,4,5-T and 2,4-D herbicides or pentachlorophenol or hexachlorophenol chemicals with which PCDD and PCDF contamination has been associated.

Current sources of PCDDs and PCDFs in the Ontario environment include incineration processes, or the use of products which contain trace amounts of PCDDs and PCDFs.



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The PCDDs and PCDFs from these sources are usually complex mixtures. The 2,3,7,8-T₄CDD isomer is generally only a small per cent of the total PCDDs and PCDFs present. This is in contrast to the problem in the United States where, because of extensive chemical manufacturing and waste disposal, 2,3,7,8-T₄CDD is a serious environmental contaminant.

Analyses carried out by Health and Welfare Canada on PCDD and PCDF residues in tissues of deceased and living persons, indicate body burdens of some PCDD and PCDF isomers in the majority of the samples analyzed. These results suggest that PCDDs and PCDFs are ubiquitous at low levels in the Ontario environment.

The first year that MOE had the capability to detect parts per quadrillion levels of dioxin was 1983. Octachlorodioxin was detected that year in raw untreated water samples taken from the Lakeview and St. Catharines water treatment plants.

Octachlorodioxin has also been detected at minute but measurable levels in the occasional raw water sample from the St. Clair River area.

Based on extensive reviews of the literature on the toxicology of PCDDs and PCDFs, the following conclusions and recommendations have been reached:

Sources and Exposure

In order of decreasing contribution to the Ontario environment, the sources have been identified as:

- i) combustion sources including municipal refuse and sewage sludge incineration;
- ii) use of chemical products such as chlorinated phenols; and,
- iii) other sources such as transboundary water and air contamination, chemical wastes, commercial and domestic wastes, polychlorinated biphenyls (PCBs) and sewage.

Based on preliminary exposure assessment, the major routes of exposure in order of decreasing contribution appear to be;

- i) ambient air in the vicinity of incineration sources;
- ii) diet, mainly some sport fish from Lake Ontario;
- iii) atmospheric PCDDs/PCDFs deposited on soil, mainly to children; and,

- iv) surface water - runoff from old chemical landfills and past discharge areas (river and lake sediments).

Recommended Maximum Allowable Daily Intake

Review of extensive toxicological data indicates that 2,3,7,8-T₄CDD is not a classical mutagen and appears to cause tumours in rodents by an indirect mechanism. The Ontario Scientific Advisory Committee concluded that a threshold exists for tumour incidence and consequently, 2,3,7,8-T₄CDD will not cause cancer in humans at levels below the threshold found in animal studies.

Based on reliable chronic animal studies and extensive but inconclusive human epidemiological data, the Committee recommended that a threshold-safety factor approach be used to develop a maximum allowable daily intake.

The proposed standard recommends an umbrella maximum allowable daily intake of 2,3,7,8-T₄CDD or its toxic equivalent from all exposure pathways based on no observable effect level from rodent cancer bioassays and an explicit safety factor of 100.

The recommended maximum allowable daily intake for 2,3,7,8-tetra-chlorodibenzo-p-dioxin (2,3,7,8-T₄CDD) or its toxic equivalent of PCDDs and PCDFs is 10 picograms/kilogram of body weight/day for humans.

Interim Drinking Water Guideline

An interim guideline for dioxins and furans in drinking water has been developed by the Ministry of the Environment consultation with Health and Welfare Canada and the Provincial Ministries of Health and Labour based on the Scientific Criteria Document. The guideline based on an allocation of five per cent of the total allowable daily intake to drinking water using a 60 kilogram person consuming two litres of water per day.

The guideline for dioxins and furans other than 2,3,7,8-T₄CDD is calculated using numerical conversion factors to convert the equivalent concentration of the other less toxic PCDDs and PCDFs to a concentration which would exhibit a toxicity similar to 2,3,7,8-T₄CDD.

PROPOSED IMAC FOR PCCDs AND PCDFs IN DRINKING WATER

Isomer Groups	Toxicity factor ¹ relative to 2,3,7,8-T ₄ CDD	Proposed IMAC ² (pg/L)
2,3,7,8-T ₄ CDD	1.0	15
M ₁ CDD	0.0001	150,000
D ₂ CDD	0.001	15,000
T ₃ CDD	0.01	1,500
T ₄ CDD*	0.01	1,500
P ₅ CDD	0.1	150
H ₆ CDD	0.1	150
H ₇ CDD	0.01	1,500
O ₈ CDD	0.0001	150,000
M ₁ CDF	0.0001	150,000
D ₂ CDF	0.001	15,000
T ₃ CDF	0.01	1,500
T ₄ CDF	0.5	30
P ₅ CDF	0.5	30
H ₆ CDF	0.1	150
H ₇ CDF	0.01	1,500
O ₈ CDF	0.0001	150,000
* excluding 2,3,7,8-T ₄ CDD		

1. Table 3.6.7C (Scientific Criteria Document p. 3-129)

2. Based on 5% of the maximum allowable daily intake
(10 pg/kg/day) for a 60 kg individual consuming 2 L/day.

The interim guideline will be reviewed as part of an ongoing federal-provincial effort to develop national standards for dioxins and furans from all environmental sources. The consideration of all routes of exposure is to ensure that the cumulative dose does not exceed the recommended allowable daily intake.